FURNITURE DESIGN CONCEPT AND TRENDS

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<td>Furniture, Design, Concept, Interior, Trend</td>
<td>Ancestors of modern human first appeared in Africa more than two million years ago. As they evolved and developed skills, they ranged further afield. The beginning of woodworking and metalworking led to major changes. The story of woodworking and furniture is inextricably linked with the story of our civilizations. During the past 300 years, as technology has advanced and social concerns have evolved into more democratic ideals, furniture makers and furniture designers have begun to acknowledge these cultural shifts within vocational and professional arenas. In the past 50 years, industrial designers, interior designers, architects, and fine artists have contributed to social change through the design and fabrication of furniture. People have used the furniture in their homes and always reflected the aspirations, fashions, and technology of the time during the history. Modernist theory in furniture seeks to integrate social function and structural integrity, incorporate industrial materials and industrial fabrication processes, and determine how well furniture performs its job. Designing furniture is parallel to but different from designing a building or creating art. Furniture takes, less time to create than a building and is one of many elements in interior space. Unlike art, furniture has pragmatic responsibility to function and often serves several intended purposes. Furniture design in disciplined work that combines technical information with prior experience, observation, and intuitive judgment, but systematic design will not guarantee good results. There are many paths one can take in designing furniture. In every case, the design process influences the final product. Designers have sought a better understanding of science, ergonomics, comfort, production and the business of marketing, branding, and distribution. Today theory engages aspects of industrialization and mass production, green design, health and welfare concerns, universal design, social use and current design trends. This paper is prepared as a case study in the furniture design with some source books about it.</td>
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1. A FEW VISUAL REFERENCES ABOUT FURNITURE DESIGN

The origins of man and global spread of homo sapiens can be interesting for us. Ancestors of modern human first appeared in Africa more than two million years ago. As they evolved and developed skills, they ranged further afield. Human development gathered pace, and with climatic change modern humans were able to migrate to new areas of the world. Human societies became more sophisticated, with increasingly complex art and evidence of rituals. The beginning of woodworking and metalworking led to major changes. Early humans had been expressing themselves artistically from as early as 30,000 years ago. Cave paintings found in France are among the oldest surviving examples of art. Along these rates the first
major settlements in the central Turkey were Göbekli Tepe and Çatalhöyük. In 12000 BC Göbekli Tepe and in 9000 Çatalhöyük had begun to develop from a small settlement into a larger, more organized community (Santon and McKay, 2011).

On the other hand, the story of woodworking and furniture is inextricably linked with the story of our civilizations. From Tutankhamun’s Ceremonial Chair to Rococo armchairs, and from 15.Louis Centre Table to Postmodern Carlton Bookcase, the furniture people have used in their homes has always reflected the aspirations, fashions, and technology of the time. Hayward, H., and others, (1975), have been prepared a source book about furniture. It’s title is World Furniture, the writers have been studied from Ancient Furniture to Postmodern and Contemporary periods.

Aranson, J., (1975), has been prepared a source book, the Encyclopedia of Furniture, it’s including all subjects about furniture such as styles and some important details.


Byars, M., (2004), in his source book, “The Design Encyclopedia”, has been studied modern and postmodern furniture and interior elements, view point of styles and details.

Hudson, J., (2006), has been studied the modern and postmodern furniture and interior elements in her source book the title is ‘1000 New Designs and Where to Find Them’.

Atiya, F., (2010), has been investigated mainly Ancient Egyptian Furniture and articles in his book of The Egyptian Museum in Cairo. The book has been bought by the writer of this paper when his visiting The Cairo Museum in 2010.

Miller, J., (2011), has been studied the story of the furniture in her book, title of “Furniture”, main lines of 11 subjects, from Ancient Furniture to Postmodern and Contemporary 1970 onward.

Fiell, C. and P., (2012), have been studied more than 1000 Masterpieces of Modern Chair, include from Abildgaard’s Klismos Chair to Zaha Hadid’s Z Chair.

Gura, J. (2012), has been studied the story of the furniture, after 1970s in her book the title of Design After Modernism. It is including “Defining the Trends ”which are consist of 15 movements from Relaxing Modernism to Unaccustomed materials.

Postell, J., (2012), in the title of his book’s ‘Furniture Design’, the writer has been carried out the systematic many useful knowledge. With a gladness, I have been used widely his valuable knowledge and experiences about furniture design in this conference paper. I would like to special thanks for his respectful studies here.
According to Postell, Architects, industrial designers, interior designers, furniture designers, engineers, fabricators, craftspeople, theorists, sociologist, cultural anthropologist, historians, and business entrepreneurs actively contribute to furniture design in unique ways and hold distinct views about it. Design furniture relies upon judgment and technical information linked to several professional and academic disciplines. The breadth and depth of knowledge necessary to design, select, fabricate, and arrange furniture in space is extensive.

Consider the influence that structural forces, material properties, the surrounding environment, ergonomics, and aesthetics have on furniture design. Reflect upon the historical, cultural, political, and societal conditions revealed by the way people sit, rest, work and play, or the human factors research upon which furniture designers rely. Generally, some references which are related with main subjects have been given respectively, without any comment at the end of the each subject in this study. Furthermore, if any participant wants to visit some useful internet sites or blogs, also he or she can find a few links at the end of the references.

This paper is prepared understanding and provides knowledge and inspiration for designing furniture. It is ordered as fallowing out lines, and includes current furniture design trends.

2. INTRODUCTION TO FURNITURE DESIGN

Before delving into the nature of furniture design, consider some useful knowledge about World and Turkey’s furniture industry. According to the Sector Report of council for Furniture Products in Turkey which was prepared by Dr. Çınar World furniture product is respectively, 450 and Turkey’s 10.6 billion US Dollars. The World’s export is 160, and import also 154 billion US Dollars in 2012. Turkey’s export is 2, and import 1 billion US Dollars, approximately in 2012. And the sector leaders are Chine % 26, USA %15, Italia %8, Germany %7 the totals production in the world in 2012. In addition, Poland and Turkey have been taken respectively, % 3 and % 1 a share from totals production of furniture in the world in 2012 (Çınar, 2014)

On the other hand, furniture design is an important problem for Turkish Furniture Industry, besides others problems (Demirci, 2004).

Dictionary and Encyclopedic sources use words like accessories, equipment and movable objects to define furniture. Words can describe the performance and physical characteristic of furniture, but those who design, make, and use furniture know that furniture design extends far beyond dictionary or encyclopedic definition. Furniture design concepts lead to the production of useful items that result in tactile experiences. In nearly every case, furniture’s is something people experience through direct human engagement. In addition, one understands and knowledge of furniture evolves with use and over time (Postell* 2012).

Designing furniture relies on intuition, judgment, design skills, engineering principles, and knowledge in a broad range of disciplines helpful with problem solving. Designing furniture requires inspiration, a concept or idea, and the commitment to give pleasure to those who use it.

The inevitable shift from designing furniture to fabricating furniture generates an appreciation for both the obvious and subtle ways in which making can influence the design process. Through the process of making furniture, one will learn about hand, power, and digital tools,
material properties and working methods, assembly processes, and the time required to finish a project. Fabricating furniture demands precise skill and workmanship and often results in a sense of craft for those directly involved in the process. Making furniture does not necessarily quarantine an ability to design furniture, but it will result in an expanded knowledge of materials, tools, and joinery, which in turn generates a broader appreciation and respect for furniture design (Groneman, 1976), (Umezu, 1988), (Efe, Gürleyen, Kasal, 2007), (Postell* 2012).

Furniture design is deeply rooted in the human condition. It is a social science that belongs to the humanities, an applied art that draws upon many design disciplines, and is dependent upon a working knowledge of materials and fabrication techniques. It is a holistic and interdisciplinary field of study.

Before going into the furniture design, consider the terms furniture and design and reflect upon the fundamental and symbiotic relationships bound in the meaning and etymology of these two words.

3. FURNITURE

**Furniture**\*noun 1. the movable articles that are used to make a room or building suitable for living or working in, such as tables, chairs, or desks. 2. The small accessories or fittings that are required for a particular task or function: door furniture, (Postell, 2012),

By many accounts, furniture includes a broad range of moveable objects organized in four main categories:

*Human body support devices
*Surfaces and objects to support various activities
*Storage and display pieces
*Spatial partitions

Furniture pieces are designed and fabricated to assist in the many ways people sit and rest, work and play, organize or display items, and partition space. This view suggests a broad utilitarian framework, in which function is perceived to be the primary intended purpose of furniture. Although function, utility, and social use are important aspects of the performance of furniture, rarely does function alone inspire great design.

Furniture design draws upon ideas of beauty, principles of design, theory, material properties, fabrication technologies, business economies, environmental design matters, and the surrounding spatial context in which it is placed, all of which are integral and intertwined with function, utility and social use. Considerations that influence what we think about and feel regarding furniture design include:

*Aesthetics (the meaning of from)
*Historical precedent (examples from the past)
*Principles of design (i.e., unity, harmony, hierarchy, spatial order)
*Function and social use (ergonomics, comfort, proxemics)
*Design processes (sketching, iterative overlays, model studies, digital modeling. Full scale working prototypes collage assemblies.
*Material (classification, characteristics, properties, availability, cost)
*Fabrication processes (hand, power digital)
*Environmental design matters (sustainability, renewable materials, off-gassing)
*Surrounding context (the spatial setting for furniture)
*Professional practice (economic, legal, and business decisions)
Utilitarian considerations can channel the development and refinement of design ideas but rarely inspire them. Utility is grounded by specific categories of social use, associated with the broader classifications of building and zoning nomenclature. In this paper, categories of social use include.

*Healthy care
*Hospitality
*Institutional
*Office
*Recreational
*Religious
*Residential
*Retail
*Storage

Broad categories of social use are dependent on particular activities and affected by specific circumstances, which are nearly always influenced by place, occupancy, and time. The Latin adjective mobile means “movable”, which is an important characteristic of furniture. The French ‘meubles’, the Turkish ‘mobilya’, and the Polish ‘namjestaj’ all translate into the English word furniture. Freedom from the physical structure of a building provides designers with an opportunity to create spatial relationships between movable elements and built-in components. The creation of spatial relationships through the size, location, and orientation of furniture pieces places furniture design within the disciplines of architecture and interior design (Eckelman, 1978), (Kawakami, 1988), (Efe, 1997), (Postell*, 2012). Spatial order and spatial organizations are including:

*Grid : a regular tessellation that divides space into a series of contiguous cells, which can then be used for spatial indexing purposes. Grids can be generated from square or rectangular cells, triangular, circular, or hexagonal formations.
*Linear : relating to, consisting of, or using lines in form or in spatial sequence.
*Centralized : drawing spatial relationships into, around, or toward a central area or point.
*Radial : elements radiating out from a central area or point. (spiraling or swirling) in a circular, lineal, or spiral path.
*Cluster : a small group of elements gathered closely together.

Buying, selling, and marketing, furniture is a business. Sales are influenced, in part, by the display of furniture in a particular setting (i.e., store, showroom, ad, journal, book, exhibit, or web site). Price, quality, function, aesthetics, historical context, and branded appeal also influence sales. As a business, furniture is carefully marketed through specific venues with consideration towards the competition and broader market demand for similar products.

4. DESIGN

Design; *noun, 1. a plan or drawing produced to show the look and function or workings of something before it is built or made. 2. The art or action producing such a plan or drawing. 3. Underlying purpose or planning the appearance of design in the universe. 4. A decorative pattern. *verb, 1. Conceive and produce a design for. 2. plan or intend for a purpose, (Postell, 2012).
One can think of design as structured play. It’s a process resulting from creative thinking, intuitive judgment, and hard work. As a process, design develops through a working method that is shaped by technical information, informed by theory, and dependent on communication skills. Design ideas develop within a conceptual and contextual framework and are dependent on the operations and abilities of the designer’s hand and head.

The design process utilizes both the right and left hemispheres of the brain. The left side of the brain processes information in a linear manner, working from part to whole relationships. It takes pieces of information and organizes them in a logical order, and then it draws conclusions. The left-brain person would enjoy making schedules and planning the fabrication of furniture. The right side of the brain, however, processes from whole to parts, holistically. It starts with the big picture, not with specific details. The right-brain person wants to see, feel, or touch furniture. Thus furniture designers who can activate both sides of the brain often enhance the design process, furthering the considerations of conceptual, structural, functional, tactile, aesthetic, spatial, economic, and cultural needs and desires, all at the same time (Kawakami, 1987), (Postell *2012).

The word design is distinct from the word project. While design entails processes of inquiry and methods for exploring and synthesizing ideas a project is the coherent resolution of purpose and presence. At some point in time, design efforts will transform into projects. A project can be revealed in a drawing model, working prototype, or fabricated work. It’s not the medium that distinguishes a design from a project; rather, it is the presence of resolved and synthesized aspects, clarity of idea, function, purpose and, very often, the intent to make real.

The words design and designate are derived from the Latin verb designate. Designate translates “to mark out,” taken from de, “of” and signare, “to mark” or the noun ‘signum’, a mark or sign. The Italian word for project is ‘la progettazione’, referring to the planning stage between design and fabrication,’la progetto’ translates into “the plan”. The word design is sometimes used to mean “the plan” and can imply planning or intending for a purpose. At the core of designing furniture is a body of knowledge and the skills necessary to integrate the tangible and intangible aspects that become furniture. Tangible aspects include:

* Materials (characteristics, workability, and finish qualities)
* Fabrication processes (tools, performance, quality, and limitations)
* Resources (time, money, and access to equipment and supplies)

Intangible aspects include:
* The program (intention, purpose, function)
* Theory and history (inquiry, rationale, precedent)
* Ergonomics and proxemics (designing for a set of activities, within the limits of the human body and the study of how people communicate in and through space)
* Knowledge about the human body and the human condition
* The design process
* Marketing and branding strategies
* Professional practice

Design skills include the ability to graphically communicate and physically model ideas. Though technical instruction can be taught, design skills need to be exercised and will improve with experience. Furniture designers need to learn how to design, sketch, draw, draft,
make study models, and use computer programs, while simultaneously developing a working knowledge about materials, fabrication techniques, and the human body, when they actively design furniture. In regard to the skills and knowledge necessary to design furniture, experience in both designing and making furniture’s is perhaps the best teacher a student can have (Kawakami, 1988), (Fargacs, 1995), (Betts, 1999), (Beyazit, 2000), (Efe, Arslan, 2008), (Postell* 2012).

5. FURNITURE + DESIGN + (X) = FURNITURE DESIGN

The primary intention of combining the terms furniture and design together is to articulate an emerging discipline in the combined synthesis of the two terms. The phrase furniture design establishes a framework for an emerging discipline that is comparable to interior design, industrial design, fashion design, or graphic design a discipline that is co-dependent with other allied design fields and, yet, one that has a core body of knowledge. It is an area of study that extends beyond the summation of furniture and design. It combines the arts and sciences, business and marketing strategies, and design and fabrication processes. It engages furniture as tangible objects, materials, and built form, as well as part of a larger history of design; informed by research, ideas, developed by design processes, theory, utility, comfort, use and aesthetics.

Furniture design needs to be practiced in order to be fully appreciated; however, some aspects can be studied, learned, and taught. Designers, educators, fabricators, industrial entrepreneurs, museum curators, and writers have developed an enormous body of knowledge about furniture design. This body of knowledge is available to the public through book, journals, museum and gallery exhibits, and web sites.

A growing number of universities and colleges offer courses in furniture design many within art, industrial design, interior design, and architecture programs. Generally, the course content and student learning outcomes from furniture offerings address the following areas of research and inquiry:

*History (societal and cultural themes)
*Human factors (anthropometrics, ergonomics, and proxemics)
*Humanities (psychology, sociology, human perception)
*Theory (inquiry, research methods, aesthetics)
*Design (processes, phases, paradigms)
*Skills (drawing, model making, digital design and fabrication)
*Materials (characteristic and performance)
*Fabrication processes (means and methods-hand, power, digital techniques)
*Professional practice

Research methods can focus one’s inquiry within the vast body of knowledge of furniture design. Through the process of gathering, organizing, and analyzing information, a stage is set for producing innovative work. Research can inform ideas and clarify specific knowledge about furniture design. It can enlighten designers and fabricators in ways to resolve technical matters regarding material properties, fabrication processes, marketing strategies, and business phoning.

There are scores of books, journals, report, professional organizations, academic institutions, web sites, furniture companies, showrooms, and galleries available to the designer today, and a wide range of professional practice venues, to support one’s study of the field of furniture design.

Efe (2015). “Furniture design concept and trends”
Within the broader study of the humanities, areas of research include:

* Human perception/psychology/behavior science
* Sociological/cultural inquiry
* Anthropometrics/ergonomics/proxemics
* Social use/notions of place-making and dwelling
* Business identity/branded environments

One can study economic, legal, and business matters in tandem with material and technical aspects of fabricating furniture. Research methods can channel and inform relationships between broad areas of inquiry and more focused studies in specific areas. They can also expand focused inquiry into broader, more complex understandings.

There are, essentially, two primary approaches to research methods:

* Empirical studies (learning by doing) i.e., designing, drawing, making, testing. Generally, an inductive approach working from concrete realities into general ideas.
* Scientific methods (systematic and quantitative) i.e. gathering information, organizing data, and statistical analysis. Generally, deductive approach working from ideas and concepts down to concrete realities.

There is a third approach that is reflective in nature, involving the study of precedent, the writings of others, or investigating design processes (These approaches tend to be more scientific than empirical). Themes and streams of research inquiry include: * Theory (human factors, ergonomics, proxemics, comfort, social use) * Design, (processes, methods, techniques) * Material research * Fabrication technologies * Professional practice * History;

Themes and streams are akin to the braids of a rope - they are interdependent on one another and collectively strengthen the totality of one’s research or inquiry (Spannagel, 1954), (Groneman, 1976), (Eckelman, 1978) (Kawakami, 1988), (Beyazıt, 2000), (Efe, İmirzi, Dizel, 2004), (Postell* 2012)

**Data Visualization: Mapping Data from Research**

Maps, line graphs, Venn diagrams, matrixes, and charts are common methods used to graphically visualize research-based data. Recently, data visualization has developed in several directions: o Theoretical, o Methodological, o new technological area. Advances include the development of a grammar of graphics, deeper understanding of human perception and implication for graphical layout, better approaches to visualizing multidimensional data, and organizing large data sets.

Consider some of the way one might map or visualize information related to furniture design. One can compare the relative strength of various glues or relative cost to manufacture comparable chairs. One could diagram the global production centers and look at the exportation/importation values regarding furniture sales broken down by country and by year. One could look at the ads in specific journals and analyze the type or spatial context of the furniture shown within the ads. However the approach, researching furniture design involves the gathering, organizing, and analyzing of information, most of which can be gathered, ordered, synthesized, and presented through a variety of graphic techniques, which include:

* Venn diagrams, o Chars (pie,bar,graph), o Two or four-axis models, o Matrixes, o Lexicons

**Venn Diagrams:** Venn diagrams indicate relationships between classifications and interrelated subsets drawn as simple, closed curvilinear shapes. As an example, consider a Venn diagram that graphically indicates the professional and disciplinary relations engaged in furniture design. Notice how the diagram sets a framework for the shared relationships and
influences between the individual subsets by the size, location, and spatial relationships of the curvilinear shapes (Figure 1).

**Lexicons**

A *lexicon* is a collection of words or terms that relate to a branch of knowledge, discipline, or part of specific population or subset. The discipline of furniture design includes a broad collection of subheadings, ranging from:

- Technical (i.e., joiner, finger joint, PVA glue, open cell, hot melt)
- Descriptive (i.e., luster, knock-down, asymmetrical)
- Process focused (i.e., sketching, injection mold, digital fabrication)
- Social use (i.e., hospitality, office, residential)
- Theoretical (i.e., ergonomic, lumbar lordosis, haptic sensation)
- Historical (i.e., ancient, rococo, classic, modern, postmodern)

Unfortunately, we could not put the Postell’s Lexicon here because of the paper limitation. The primary goal for many furniture designers is to create designs that improve upon existing products or to provide entirely new designs that deliver new ways to work, rest, or play. In doing either, designers broaden the world through fresh and personal points of view.
Figure 1. Venn diagram indicating shared and dependent relations among the disciplines of Art, Industrial Design, Engineering, Architecture, and Interior Design. High technologies (workmanship of certainty) stem from the left side of the diagram, while lower technologies (workmanship of risk) stem from the right side. Diagram by Jim Postell, 2011

The primary goal for many furniture designers is to create designs that improve upon existing products or to provide entirely new designs that deliver new ways to work, rest, or play. In doing either, designers broaden the world through fresh and personal points of view. As a tangible reality, furniture is composed of materials and finishes, held together by engineered joinery, and experienced physically and spatially. Furniture is also composed of intangible aspects that reveal ideas about comfort, ergonomics, proxemics, cultural meaning, social status, use, spatial organization, and aesthetics. These intangible aspects serve as a basis for theory. Not all dimensions are measurable, and neither are details limited to physical characteristics. It is imperative to consider tangible and aspects concurrently when designing and making furniture.

Before we delve into the intangible aspects of theory, let’s first consider the broader taxonomy of function and social use categories within a cultural and societal framework, followed by the more descriptive and measurable characteristics of built-from.

6. FUNCTION AND SOCIAL USE

The Best of Today’s furniture provides for many needs and desires, revealing the latest conceptions of function and social use. In this study, function is interpreted broadly; it is concerned with matters of structural integrity, utility, and aesthetic. We shall begin with the following categories of utility. Human Body Supports, Activities, Containing, and Defining Space (Postell, 2012).

**Human Body Supports; Sitting, Resting, and Sleeping**

Furniture directly supports the human body in the course of sitting, resting, and sleeping beds, benches, car and plane seats, chairs, couches, futons, hammocks, inflated therapy balls, mattresses, rockers, sofas, and wheelchairs are some of the many furniture pieces designed to support the human body. At a minimum, human body supports should allow for body movement, support the weight of the body as evenly as possible and minimize uncomfortable pressure points. Man-made body supports include elevated platforms and raised surfaces used for sitting and resting. Backless benches include elevated platforms and raised surfaces used for sitting and resting. Backless benches made from logs, retaining walls, and steps can support a wide range of people and activities. These furnishings are often site-specific, incorporated in the surrounding landscape.

It is a challenge to integrate formal aspects of composition, material properties, fabrication techniques, and functional use in the conception of furniture, but the best designers do so.

**Squatting and Sitting**: Squatting is considered by many to be the first and most natural means of sitting and is especially prevalent in nomadic, African, and Eastern societies. Squatting works a variety of muscles and places the body close to the ground. Today, out of the tens of thousands of chairs available, stools and inflated therapy balls are among the few furnishing designed to accommodate as quitting posture. Squatting is physiologically healthy and doesn’t rely on the use of or need for chairs.
In some places throughout the world, across-legged seated posture is common, while in other places, such as in Japan kneeling is preferred. But most people in Western societies have cultural and societal preference for chairs. Today, many office chairs are designed for dynamic movement and multiple task such as typing, and reading. Herman Miller’s office chairs and Chitose’s office chairs can be a good examples in this subject (Yagi, 1987), (Chitose, 1988), (Postel* 2012).

Can a chair that is designed specifically for reading a newspaper be used to type a report? Typing requires the maintenance of correct eye position relative to the top of the computer monitor. Arms and wrists need to fall at the level of the keyboard. The spine often leans forward when typing. An ideal seat rake (the angle between the seat pan and the seat back), most researchers and designers would are that the seat rake for reading should be greater than 90 degrees and less than 110 degrees. Seat pan the surrounding furnishing, the intended purposes, and the physiology of the user. Body posture will change frequently, allowing for different postures and body movement is a important as determining appropriate dimensions and angles (Panero, and Zelnik, 1988), (Postell, 2012).

Activities: Eating, Reading, Typing, and Writing
People depend upon furniture for a variety of purposes and activities. Furniture influences how experience’s a meal, reads a book, types a report, works at a computer, or writers at a desk, though the relationships between design and experience need to be studied further. Eating reading, typing and writing are performance based activities. Observing and analyzing correlations between furniture, the human body, and activities, can help designers better understand how and why furniture performs well or poorly.

Containing: Storing, Displaying, and Organizing
Storing, displaying, and organizing items are also determinants of function. Storing and displaying are separate functions that can occur simultaneously, as in a jeweler’s display case.

Defining Space; Enclosing, Shaping, and Partitioning
Partitioning space is another determinant of function. Space can be subdivided or unified through the use of built-in furnishing, privacy screens, and shelving system. Office storage systems can provide flexible arrangements, dividing and subdividing large spaces into more manageable spaces, or more private spaces (Itten, 1976), (Kawakami, 1988), ( Postell* 2012).

7. FORM SPATIAL ORGANIZATION AND TYPOLOGICAL ORDERS

Form
Form constitutes the physical and spatial structure of an entity however from is not a synonym for mass or volume. The Circle designed by Hans J. Wegner (1946) is considered form because its shape characteristics are determined by the structure of sitting in conjunction with the conditions of its geometry. Consider the forces that can influence form (i.e., moment, shear, compressive, tensile and lateral forces) resulting from gravity, daily use, and live loads. Forces applied to furniture during use place significant demands upon design. Structural forces are present in all of the physical systems and components of furniture, keeping them from failing apart.

A review of internal and external forces during design might help to develop a better understanding of how shear, moment, and lateral forces affect furniture. Eventually,
prototypes may need to be fabricated in order to test the structural integrity of a design. Furniture designers need to be attentive to basic engineering principles throughout the design process and aware of concepts such as deflection creep and load failure as materials and dimensions are determined (Eckelman, 1978), (Efe, Erdil, Kasal, 2003), (Efe, Kasal, Arslan, Likos, 2009), (Postell* 2012), (İmirzi, Efe, 2013), (Erdil, Diler, Kasal, Efe, 2013). Materials and fabrication techniques influence form in addition, from can inspire the appropriate use of materials and fabrication processes.

Furniture can express personal (private) and communal (public) space. Form results from the many ways of thinking about structure, materials, function, social use, and technical considerations. Shape is dependent upon descriptive geometry and in this section is organized into five categories angular composite, curvilinear orthogonal and sectional/modular (Zusne, 1970), (Itten, 1976), (Efe, İmirzi, Dizel, 2004), (Postel* 2012).

**Angular;** All geometry is composed of angles, lines and planes, but canted, no orthogonal and no curvilinear geometries are referred to as angular. Gerrit Rietveld’s stackable Zig-Zag chair (1934) is visually dramatic due to the bold angular relationships between the chair’s support, seat pan, and seat back. **Composite;** Composite furnishings, utilize two or more geometric systems such as curvilinear and orthogonal or two or more distinct materials such as stone and wood in one piece. **Curvilinear;** Inflated therapy balls (gym balls) are simple curvilinear forms. Gym balls have neither front nor side, unless these are implied by other characteristics such as material seams or branding logos. They offer a practical, inexpensive, and healthful means of sitting. Compound curves are curvilinear shapes that bend in two ore more directions. **Orthogonal;** Orthogonal furniture is composed of rectangular geometric forms created by lines, planes, and volumes positioned at 90 degrees to one another. Computer rendering of two (Baltic birch) plywood chairs designed and fabricated by artist Donald Judd, 1991. **Sectional / Modular;** The components need not be similar or even proportional to one another. Modular furnishing rely upon proportional corrections between components, having repeatable or geometric correlations between parts, which may be arranged in a variety of ways. Sectional and modular furnishing are inherently flexible, designed as a system of components that can be assembled, disassembled, and very often reconfigured.

**Spatial Organization**

Space is the medium that architects, designers, and artists use to compose form. Space and form are codependent. Without space, form would not exist, and without form space could not exist. Furniture designers should consider the following spatial relationships.

*Spatial relationships between people and furniture
*Spatial composition of furniture and interior space
*Spatial relationships, between various components of furniture
*Spatial extensions based upon the geometries of furniture

Designers draw in plan, section, elevation and perspective and must be able to communicate design ideas in a didactic as well as a perceptual manner. Throughout the design process, designers often switch from abstract to perceptual representation. **Centralized;** Centralized spatial order draws focus toward the center of a space. A centralized space (or any spatial typology) is an experienced phenomenon that is influenced by many factors. Furniture, material, people, activity, acoustics, and lighting are variables that influence the perception of space.
Clustered; Clustered arrangements are apparent whenever a group of three or more elements (or axial orientations) share the same field. Open loft spaces are spatially organized by the location and orientation of furniture. Clustered arrangements of furnishings can create zones of activities, with each zone defining a specific component of “home”. Space between clustered furnishings, when liberated from the confines of structural columns and wall partitions, can result in interstitial space (in-between space).

Grid; Furniture designers rely upon grids and underlying templates in their development of form and spatial organization. Grids are useful in transferring the order of a underlying spatial organization. Distinctions between grids, can vary by measure and/or geometric order.

Linear; Lines are made from two or more points and generally are conceived a being straight but they also, curve, warp, and transform.

Radial; Sociofugal spaces are perceived as outward-oriented space. Radial spaces are distinct from inwardly focused, centralized, sociopetal spaces.

Typological Orders
Order results from the confluence of ideas present in the conception and development of design. Furniture is nearly always movable, but not all furnishing are designed to move easily. Furniture can be stationary, but not all furnishings are mechanically attached to the floor, wall, or ceiling. Furniture can be adjustable, but not all furnishings are specifically designed to transform from one form into a different form. Most furniture can be taken apart but not all furnishings are designed and distributed as knock down or flat-pack. Generally most furnishings are freestanding; however, not all pieces are specifically designed to be seen and experienced in 360 degrees. Freestanding pieces can take advantage of a sculptural and dynamic quality inherent in the nature of form. The typological orders determined as fallow;


Assembled/Disassembled - Flat-pack/knock-down; Ready –to-assemble (RTA) furniture is distributed and sold in an unassembled state and assembled by the consumer RTA furniture is also known as flat-pack or knock – down furniture. The Swedish furniture and accessory company IKEA sells unassembled.

Built-in/Stationary; When built-in furniture is carefully integrated with its surrounding space, it can enhance the continuity of the architecture. Built-ins and casework require on – site installation and mechanical attachment to a floor, wall, or ceiling. In these situations, designers must consider ways in which relatively imperfect or irregular existing conditions will receive precisely fabricated elements.

Freestanding; Most furnishings are freestanding, but a few are designed to be experienced in the round.

Inflatable; Waterbeds, inflatable air mattresses, therapy balls, and beanbag chairs are internally “filled” and externally “sheathed”.

Mechanical (Transformative Machines for Living); Mechanical joinery can allow furniture to transform into different shapes. Chair table, folding chairs, butterfly tables, extending draw tables, etc.

Movable; Movement can enhance function. Alvar Aalto’s Tea Trolley serving cart (1936) was designed. Wheeled Tea Trolley serving cast, designed by Alvar Aalto (1936) produced Artek, (Itten,1976), (Eckelman, 1978), (Kawakami, 1988), (Beyazit,2000), (Postell* 2012).
8. FURNITURE DESIGN THEORY

Theory; A set of statements or principles devised to explain a group of facets or phenomena. A belief or principle that guides action or assists comprehension or judgment.

Inquiry

Regarding our interest in the subject of furniture design, the question asked are broad and encompassing. What is furniture design? What is it place in the world? Who are furniture designers? How is furniture design done, and for whom is undertaken? What are the principles of furniture design, and why are they important to know? The Latin word theria and the Greek word theoro mean “to see”, “seeing the sights”, or “seeing within” and are the origins of the English word theory. These origins point to the importance of looking within one self as well as looking outward to the world (Postell, 2012).

Furniture designers rely upon intuitive judgment (looking inward), utilize materials and processes (looking inward), utilize materials and processes (looking under) draw upon prior experience (looking backward), and observe how people do things (looking outward) when seeking inspiration for their own work. Inquiry directs the discussions of furniture design toward technical, and aesthetic matters. In doing so, theory reveals knowledge to help determine good design. Knowledge and ethos in design change over time, and so does theory. When new evidence about an area or subject emerges, theory will adjust accordingly. Our understanding of aesthetics, comfort, and fabrication technologies is different today than it was 50 years ago and likely will continue to evolve.

Inquiry sustains a body of work-all types of work. What ideas contribute to good design? Can one design be considered better than another? Aside from aspects of comfort and workmanship what makes a good chair good? We have a host of “best –sellers” in many different typologies, designed and marketed according to theories of ergonomics, human factors, and anthropometrics. Which designs are the best? Aside from considerations of price and comfort, what qualities make them the best? Expanding upon the relationships between furniture and space, how might the variables of placement and orientation draw furniture into an architectural thesis?

During the past 300 years, as technology has advanced and social concerns have evolved into more democratic ideals, furniture makers and furniture designers have begun to acknowledge these cultural shifts within vocational and professional arenas. In the past 50 years, industrial designers, interior designers, architects, and fine artists have contributed to social change through the design and fabrication of furniture.

Designers have sought a better understanding of science, ergonomics, comfort, production and the business of marketing, branding, and distribution. Today theory engages aspects of industrialization and mass production, green design, health and welfare concerns, universal design, trans generational design, and social use. The culture of design continues to reach out to a broader market and is fueled, in part, by designers working on designs that are more or less within economic reach (Postell, 2012).

The lessons and ideas drawn from others are important to assimilate because they can help inspire and formulate personal views about furniture and design (Postell *2012), (Fiell, 2012).
Ludwig Mies van der Rohe once said, “A chair is a very difficult object. A skyscraper is almost easier. That is why Chippendale is famous.” Consider the following explanations:

1. A chair is an extension of the user, and no two users are exactly alike. No two users sit, squat, or move about in the same manner.

2. A chair is used for many different purposes (e.g., to rest, write, type, read, talk, etc.) Each of these activities could result in a specific chair, yet often chairs are intended to be multifunctional.

3. Sitting is inherently a challenge to one’s well-being. Research indicates that standing is healthier than sitting. The body needs to move about, frequently change positions, and adjust itself constantly.

Sitting is considered by many to be a static activity, but in fact, the human body needs to move and stretch continually. The challenge in designing a chair extends beyond physical parameters of static posture. Theories abound regarding the dynamics of body movement. Ideas about ergonomics have evolved significantly, and knowledge in the area of anthropometrics has developed as well. It is important to study ergonomic theories, and it is generally useful to produce working prototypes and take the opportunity to experience and evaluate design ideas.

Designing and fabricating furniture is one way of learning about furniture design. Remember to note the successes and failures that occur from conception through the life of a piece. Enquiry is an active part of the process of design, making observations and taking notes along the way. Successes and failures during the process are part of one’s research. Theories develop from designing, fabricating, and experiencing furniture, as well as through reading, writing, observing and studying furniture (Panero, and Zelnik, 1988), (Postell*, 2012).

**Firmitas, Utilitas, and Venustas**

Architectural theories are dependent upon three interrelated terms—firmness, commodity, and delight. The Latin terms of origin ‘firmitas’, ‘utilitas’, and ‘venustas’ are attributed to Vitruvius text. Architectural, written in 79 A.D. Sir Henry Wotton translated the Latin terms in his 1624 treatise. The Elements of Architecture, as follows. “The end is to build well. Well building hath three conditions: firmness, commodity, and delight.

From this phrase - ‘firmitas’, ‘utilitas’, and ‘venustas’ - a theoretical framework emerges that is useful in guiding broad inquiry relative to furniture design.

- **Firmitas**: Structural integrity tectonics, and composition (how furniture is made and held together).
- **Utilitas**: Use and experience (how furniture functions and feels).
- **Venustas**: Form, spatial organization, and aesthetics (how furniture looks, fits within space, and expresses meaning).

Theory is connected to, and intertwined with the spirit of the age in which it develops. Furniture design supports this fact and needs to be considered in context. Ideas and perspectives about furniture embrace a range of issues that change over time and are influenced by culture, politics, economic, and place. Theories of furniture design consider the composition of parts (i.e., tectonics and structural integrity), function (i.e., ergonomics, comfort, and social use) and meaning (i.e., aesthetics and semantics) of built form (Postell, 2012).

**Firmitas**: Firmness (firmitas) refers to the structural integrity and tectonic composition of furniture. Firmness is dependent upon fabrication techniques, the quality of workmanship, and the spatial relationships among the parts and between the parts and whole. Applied forces, such as lateral forces challenge the physical integrity of furniture lateral forces, live loads and
gravity should be carefully considered when designing furniture. Lateral forces routinely cause and connections to fail. Braces, skirts, folds, and applied hardware serve to resist lateral forces and improve the structural integrity of furniture.

On the other hand wood is one of several materials used to make furniture. Unfortunately, wood is not a uniform and stabilized material. It has a range of physical characteristic and properties. Both the designer and the fabricator to understand the unique characteristic of search species when using it in design. The cellular structure, the type of adhesive, the joinery, and the moisture content of lumber affect the structural integrity of the design. Also the physical properties of other materials such as fabrics, metals, and plastics are equally important in furniture design. According to Smardzewski, strength and stiffness of skeleton-frame- furniture depends, primarily, on constructional, material, technological and use factors (Eckelman, 1978), (Efe, Erdil, Kasal, 2003), (Smardzewski, 2004) (Efe, Kasal, Arslan, Likos, 2009), (Postell* 2012), (İmirzi, Efe, 2013).

Utilities: Commodity (utilities) is determined from a range of observations and experiences based upon how well furniture functions and feels in this study commodity; refers to comfort, ergonomics, social use, and the tactile experience of furniture. It introduces ideas that contribute to an area of knowledge knows as human factors, which involves scientific research on the interface between the human body and the built form. Human factors data are objective and scientifically determined but the data are always subject to political social frames of reference. Human factors encompass many areas of research including accessible design, anthropometrics, ergonomics, posture, proxemics, and universal design. Furniture physically and spatially embraces the body. Considering tactile experience (haptic sensations) in design is important.

- Ergonomics; (i.e., fitting the task to work within the limits of the human body) presents challenges through which design is often measured. Commodity can be considered the interface between function and ergonomics. Design solutions seek to find a match between the measure and physiology of the body, the tactile experiences of use, and aspects of health, welfare, and pleasure.

Observing documenting, and analyzing how people sit reinforces compelling arguments for the need to maintain muscular strength, provide easy access, and allow for a range of postures and body movement while being seated. Personal observations and individual inquiry may challenge traditional theories of ergonomic, which in the past attempted to facilitate static seated postures for extended periods of use. (Grandjean, 1971), (Schacel, 1974), (Efe, İmirzi, Dizel, 2004), (Postell* 2012), (Erdil and others, 2013).

Changing body postures, body movement, supporting the body’s weight, and maintaining lumbar lordosis are important aspects to consider when designing a chair. Today we understand more about the measurement and physiology of the body than ever before. However, designers should remain open to new ideas about comfort and use, because our knowledge of ergonomics and human factors is in a constant state of flux.

Anthropometrics; is the science of determining anatomical measurements and understanding the physiology of the human body. Researchers working in the area of anthropometrics generate statistics from different age groups, body sizes, and body proportions, different ethnicities, gender distinction, and different populations to understand the similarities and

Efe (2015). “Furniture design concept and trends”
differences in the human form. Knowledge of the physiology and measurement of the human body’s is critical for designing furniture.

What is a reasonable height of a chair’s seat pan for the average adult? What is the height of the seat pan relative to the length of the body’s popliteal dimension? What is a reasonable angle of the seat rake for reading? How might the choice of materials contribute to the experience of sitting? What is a reasonable height of a table surface for dining for an average man, woman, child, or adult in a wheelchair? Where on the body is the vascular flow most susceptible to outside pressure?

Body posture and appropriate support are some of the many dependent relationships that furniture designers need to consider and one can analyze these in plan as well section. To help determine dimensions, materials, and form, designers may inquire; What is the intended purpose of the chair or table? Who are the intended users? How will the furniture be used? The significance of these questions becomes evident when a chair or table is designed for the first time. For example, Smardzewski, discussed the methodology of the assessment of ergonomics of chair, a table and a chair + table set, where the assessment criteria were: anthropometric dimensions of user, stiffness of seat and the value of contact strains on the seat surface.

Anthropometrics is a term that industrial designers, interior designers, engineers, and architects share with researchers working in the area of human factor. Human Scale was a significant step forward in the process of documenting the physiology and measurement of the human body.

Furniture designers should seek to understand as much as possible regarding the physiology and measurement of the human body and its interface with built forms (Panero and Zelnik, 1979), (Smardzewski, 2009, (Postell 2012).

Ergonomics; focuses upon the study of work and how work is done it seeks to establish a healthy fit between performing a task, the limits of the human body, and the designed product. This thesis is based upon the assumption that the body is healthier if it is not stressed beyond the normal limits of muscle, bone, posture, and so on. The term ergonomics entered the modern lexicon when Wojciech Jastrzebowski used it an 1857 article on the subject.

The term ergonomic comes from the Greek words ergos, meaning “work”. And nomol meaning “natural laws. “An ergonomic design solution adapts the task to fit the natural limits of the person rather than forcing the limits of the person to conform to the task or the space. The goal of ergonomics to optimize how well design (or habits) can enable work to be accomplished, considering the physical and psychological limits of the human body. Body posture and the physical limits of reaching pulling, lifting, and pushing are factors to consider in ergonomic design. (Grandjean, 1971), (Schael, 1974), (Beyazit, 2000), (Efe, İmirzi, Dizel, 2004), (Postell 2012).

Many office chairs are labeled ergonomic seating. A chair is ergonomic only when the limits of the user correlate with the task at hand. A chair with a right - handed tray is not ergonomic for a left-handed user, and fixed auditorium seating is not ergonomic for interactive class, discussions. The term ergonomics applies to experiences and tasks (which are temporal) and less directly to objects and furnishings.

Nerves, tendons, tendon sheaths, ligaments, and muscles are frequently injured by poor design and poor use.
Today the need to make work efficient incorporates for making work and the tools used to work with more healthful safe and environmentally green.

Furniture designed from an ergonomic perspective focuses upon task-specific operations. Ergonomic furniture is marketed to businesses where liability and public welfare are of concern and functions such as typing. Lifting and pilling may cause medical problems.

Smart seating, adjustable work surfaces, wrist relaxers, posture guidelines for working at a computer keyboard and monitor, policy concepts regarding the need to take breaks, the importance of vascular circulation, and body movement have been introduced and integrated into ergonomic research topics (Chitose's Office Chair, 1988).

The size, material, and form of chairs should provide ergonomic support and utilization function. Dimensions of the user and operative tasks are important considerations in chair design. In addition, four utilitarian factors ought to be considered when designing human body supports.

1. Supporting the weight of the user
2. Eliminating pressure points
3. Enabling body movement
4. Maintaining lumbar lordosis

Supporting the Weight of the User; The first consideration is how to support the weight of the user or the task at hand. The seat rake is the angle of the seat back to the seat pan. Designers and ergonomic researchers study the correlation between seat rake and posture.

Eliminating Pressure Points; A second consideration is the need to eliminate or minimize pressure points. Pressure points can constrict the flow of blood through the body and can affect the nerves that transfer sensation to the brain. In ergonomic seating a waterfall seat front, a seat height that is no higher than the popliteal dimension, an upholstered seat, or a contoured seat pan are strategies to minimize uncomfortable pressure points while being seated.

There are two triangular seat bones inside the buttocks called ischial tuberosity’s. Research indicates that approximately 65 percent of the body’s weight is transferred through these bones to the seat of the chair when sitting. The shape, angle, and curvature of the seat pan affect the around of pressure applied to these two bones when sitting. The height of the seat pan ought to be slightly less than the length behind the user’s knee to the floor.

The vertical dimension from the underside of the thigh at the knee to the bottom of the foot on the floor is the popliteal dimension. After adjusting for heels, clothing, and other issues the popliteal dimension is useful in determining the height of the chair seat. The height of the seat pan in mass-produced chairs is generally (43-2 cm) –falling in the middle of the American National Standards Institute (ANSI) recommendation for the range of seat height adjustment (38.1 to 52 cm). In theory consider a 135 –degree angle between the spine and the thighs as a place to start, bringing the knees significantly below the seat pan. A different but related angle to consider is the seat-to-back angle, which generally ranges from 95 to 105 degrees ANSI recommends that this angle be between 90 and 105 degrees.

Enabling Body Movement; A third ergonomic consideration is to enable body movement while being seated. Though posture is dependent upon time and societal norms, it is not a static condition. The human body is always moving, seeking comfort and different positions when sitting or resting. Consider chair designs that allow people to distribute their weight adjust their posture, and use their muscles when sitting. Designers should allow enough space and appropriate body support in their designs.

Maintaining Lumbar Lordosis; The forth aspect to consider in supporting the human body is the curvature of the lower lumbar vertebrae and the angle of the hip when seated. Contemporary theory seeks to maintain lumbar lordosis while seated, which is the natural
curvature of the spine when standing. When the lower lumbar vertebrae are compressed forward (which occurs when sitting on a flat surface), they become pinched. This can be painful and harmful to the vertebrae over time. Inward compression of the lower lumbar vertebrae is called kyphosis. Designers should avoid this condition through design whenever possible and consider ways of maintaining lumbar lordosis for the seated user. Rotating the pelvis forward helps maintain the natural curvature of the spine.

Moving from a standing position (lumbar lordosis) to an upright sitting position bends the hip joint and rotates the pelvis, flattens the lumbar curve (kyphosis) of the back, and strains the muscles in this region. One should attempt to maintain lumbar lordosis while in a seated position.

Posture also reveals formal and informal patterns of behavior, spatial communication and social interaction. An ideal posture does not exist because human beings cannot hold any single posture for long periods of time. Posture is always changing, driven in part by the need to redirect the flow of blood and relieve pressure applied to the body over time.

How people communicate in and through space and how people sit directly affect how well furniture functions and feels.

- **Posture:** is concept that reveals continuous body movement when sitting, standing, or walking. The position of the body is always shifting to seek comfort. Posture expresses social-spatial communications between people, driven by cultural norms, and physiological factors. Poor posture has been a factor in litigation cases involving worker’s compensation claims and loss of income due to medical disabilities resulting from improper design and use. Poor work habits and bad posture contribute to physical problems with the back, neck, and wrists, which motivates further research on ergonomics and posture.

- **Body profile studies:** Research studies during the past 20 years have pointed out that when sitting in this manner the hip joints actually bend only 60 degrees. An additional 30 degrees of bending occurs in the lumbar region of the lower back. This bending flattens the lumbar vertebrae straining muscles in this critical region down (with and without body support). Contemporary thinking suggests that a sitting posture in a natural resting position is healthful. This allows the spine to carry the body’s weight in a more comfortable way.

- **Proxemics:** Cultural and societal notions of how people interact with one another and their patterns of behavior are important to understand. The size, location, and orientation of furniture directly influence patterns of behavior. Seating and table arrangements can influence the perception of space and contribute to the social and psychological experience of space. Furniture designers need to understand the social grouping dynamics and behavior patterns of those who will use their designs as much as they need to understand code regulations and occupancy standard when organizing and composing furniture in space (Grandjean, 1971), (Schaecl, 1974), (Paniero, 1979) (Efe, İmirzi, Dizel, 2004), (Postell* 2012), (Döngel, 2013).

In *The Hidden Dimension*, Hall pointed out that social distance between people could be measured and described in four categories.

*Intimate distance for embracing, touching, or whispering (15.2-45.7 cm)
*Personal distance for interactions among good friends (0.45-1.21 m)
*Social distance for interactions among acquaintances (1.21 – 3.65 m)
*Public distance used for public speaking (over 3.65 m), (Postell* 2012).

**Venustas:** What distinctions can be made between aesthetics, beauty, and delight? Delight is a personal reaction to physical or visual stimuli and is subjective. Pleasure is revealed by sensation through the tactile nature of materials, finishes.

Traditional ideas of beauty suggest that geometry, proportion, and form inspire and please both the mind and the soul. In architecture, design, and art, ideas about beauty, geometry,
proportion, and form fuel the sensation of delight. In furniture design, placement and orientation in space along with the visual and tactile experiences generate delight.

One way to understand the idea of beauty in furniture is to consider the notion that design is the organization of parts into a coherent whole. Beauty is not limited to aesthetics. Aesthetics comes from the Greek word aesthetics, meaning “perceptive, especially by feeling. Aesthetics is the branch of philosophy dealing with the beautiful. Aesthetic theories intertwine with design principles. They serve as lenses through which judgment is made about formal qualities in furniture design.

Geometry; Euclid’s Thirteen Books of the Elements was written around 300 B.C. and was translated by Sir Thomas L. Heath in the 19th century. It presents the rules and principles of geometry, with a focus upon lines, angles, planes, circles, ratios, proportions, polygons, and cylinders. It is an important source that covers the mechanics of geometry. Geometry is the foundation of composition. In order to conceive, design, and draw furniture, one must have a technical or intuitive knowledge of the rules and principles of geometry.

Proportion; Proportion is derived from relationships within the human body (digit, cubit, head, arm, proportion of elegance) and from relationships between door size, windowsill height, room dimension, and so on in many ways, furniture responds proportionally to the human body and to the interior space in which it is placed.

Ad Quatratum and ad Triangulatum; Ad quadratum (“by the square”) and ad triangulatum (“by the triangle”) are geometric systems that designers have used to create unity in their work (Postell *2012).

The Golden Section; The Golden Section is a ratio that results when a line is divided so that the short segment has the same relationship to the long segment that the long segment has to the sum of the two parts. Its works out to be unique mathematical proportion 1-1.6182. Analysis of the geometric basis for many design elements that employ the Golden Section illustrates an almost exact mathematical progression known as the Fibonacci series of numbers 0,1,1,2,3,5,8,13 in which each number is the sum of the two numbers preceding it.

Modernism

Modernism is more than a style. It is a philosophical way of thinking about architecture and design. It came into being in an emerging industrial world that rapidly embraced mechanization. When modernism emerged in the Western world in the 1930s, design had difficulty building upon or acknowledging history. It was an ideology encapsulated by the statement “form follows function” often attributed to Louis Sullivan but initially used by the 19th-century sculptor Horatio Greenough (1805-52). The modernist idea is that function and utility can and should create form. The question is, what is function? Modernist theory in furniture seeks to integrate social function and structural integrity, incorporate industrial materials and industrial fabrication processes, and determine how well furniture performs its job. Modernism considers function as a broad term with meaning at
many levels. The following list outlines a few concerns that affect the notion of function within the view of modernism.
*What is the intended purpose of the furniture?
*Are there secondary or tertiary purposes (social uses) to consider?
*Who will use the furniture, in what context and how often?
*What tools, resources, energy, and processes are needed for fabrication?
*What are the waste by-products of fabrication and the resources needed for distribution?
*What societal or economic impacts result from either the fabrication or consumption of the furniture?
*At the end of its life span, how will disposal, recycling, or biodegrading occur?

The modern understanding of function relates back to utilities but has a broader definition. In the context of its conception, function is aligned with logical thinking, tectonic assembly, and industrial processes more than with a desire for comfort or ergonomics (Kawakami, 1988), (Hudson, J., 2006), (Postell* 2012), (Gura, 2012).

**Systems Theory:** The human body is a network of interrelated systems (nervous, skeletal, muscular, vascular, etc.) Similarly, furniture can be conceived of as a series of interrelated systems in the 1960s and 1970s. It was popular to think about design as the management of systems. One did not design a chair or a table, one designed systems with which human and building systems interacted. Office furniture was known as systems furniture because of its integration of physical structural, spatial and electrical systems. Seating devices were referred to as human body support systems.

Systems theory grew out of human factors engineering and deconstructed the modernist use of the word function into an array of systematic relationships.

When design is considered as a series of interrelated systems, it reshapes one’s thinking about style and aesthetics. Mapping and modelling the human body while standing, leaning, squatting, or sitting down is a good exercise to help designers understand body posture and body space. Human factors specialists rely upon scientific methods and an enormous amount of research to better understand aspects of measure, posture, and physiology.

**Built Form and Culture:** People from different cultural backgrounds view the built environment in different ways. Correlations between furniture, culture, and use develop into complex associations between built form and culture. Culture is a frame of reference through which furniture is given social meaning, but culture is not the only referent.

Sociologist, cultural anthropologists, engineers, and psychologists have developed a body of knowledge that has advanced the importance of cultural and social theories in the sign and architecture.

Our evolving understanding of societies and cultures relative to built forms has influenced the collective view of theory, making humanism a primary consideration in design research.

**New Formalism:** Theories of Digital Form; Digital software programs and digital machines have begun to affect our thinking about design. Digital technology may well become more than a tool in the design process. It may become the vehicle and the means of generating form.

The opportunity to reconsider traditional processes of design and fabrication is open to all designers now. And these opportunities may help designers in their inquiry to determine what makes good furniture good. Or, more to the point, digital technology may shape the very frame of reference used to determine how designers think about technical, functional and aesthetic matters (Cerver 2000), (Byars, 2004), (Miller, 2005) (Postell* 2012), (Gura, 2012), (Fiell, 2012).
9. DESIGN

Design is a process. The process can be simple or complex. It can take a few minutes or several years to accomplish. It can involve one person or a group of people. There are intuitive processes and there are systematic processes. This chapter focuses on the processes of designing furniture. It introduces principles of furniture design and covers the phases, processes, and skills involved.

The ultimate goal of design is to synthesize tangible and intangible aspects and to create a unified whole out of an array of parts. Achieving part-to-whole relationships between components and interrelated systems is an important goal of design.

In this sense, designing is a means of attaining order, arranging physical and spatial components along with intangible aspects to form a unified whole. Order governs the composition of any entity, such as the human body, furniture a building, or a natural landscape.

Designing furniture is parallel to but different from designing a building or creating art. Furniture takes, less time to create than a building and is one of many elements in interior space. Unlike art, furniture has pragmatic responsibility to function and often serves several intended purposes.

Furniture design in disciplined work that combines technical information with prior experience, observation, and intuitive judgment, but systematic design will not guarantee good results. There are many paths one can take in designing furniture. In every case, the design process influences the final product.

If you change the way you design, then you will change the way you think about design and consequently, what you design. Paradigms about the design process (methods, required skills, anticipated outcomes etc.) significantly based upon professional, academic, and programmatic boundaries.

Nonetheless, design principles are a common thread in all disciplines, so we begin with a brief review of design principles (Zelanski,1984),(Schuster,2000),(Beyazıt,2000), (Postell *2012).

**Design Principles**

Design principles provide criteria that describe formal intentions. The intended purpose of a chair or table can begin with a range of needs or desires and develop through any number of processes. Along the way, furniture designers are confronted by design principles, which require the eye and the hand to work together in a complex system of thought and action. The principles of design covered in this chapter are.

*Balance, Structural and Visual Symmetry and Asymmetry
*Continuity, Unity, and Variety
*Dynamism and Stasis
*Hierarchy and Emphasis
*Contrast (Juxtaposition)
*Rhythm and Pattern
*Scale and Proportion

**Balance: Structural and Visual, Symmetry and Asymmetry:** Visual balance is the spatial weighing of a composition around an axis. Structural balance involves the physical equilibrium of freestanding elements such as chairs and tables. Furniture must be able to withstand lateral, shear, live, and moment forces. Visual balance and structural balance are related but distinct concepts.

o Structural Balance; Structural balance considers the forces in furniture to be in equilibrium. When forces are not in equilibrium, cantilevers can fail, shelves can sag, and furniture can tip
over. Furniture must be able to withstand lateral forces (forces applied from the side), shear forces (internal forces working in parallel but opposite directions), and moment forces (rotational force applied to joints). Structural forces inspire design ideas and are an important consideration in the conception of form.

In cases where furniture is precariously tall and narrow or where the center of gravity lies beyond the tipping point, it may become necessary to attach furniture to a floor, wall, or ceiling in order to maintain structural stability.

There are dimensional limits to the horizontal span of shelving before deflection occurs and imbalance appears. Shelving system, bred frames, music stands, grandfather clocks, cabinet, doors, and speaking podiums all depend upon basic engineering principles to maintain structural balance and function safely.

- **Visual Balance:** The spatial weighing of visual balance expresses either symmetrical or asymmetrical composition.
- **Symmetry:** is a form of balance where a component (or several components) is mirrored along an axis. Symmetry can be expressed bilaterally (around a common axis) or radially (around a common point).
- **Asymmetrical balance** is dynamic and appears in equilibrium along an axis through its form, though it cannot be mirrored.

**Continuity, Unity, and Variety:** The wall–mounted wood paneling that transforms into a sinusoidal bench in Gunnar Asplund chapel at the Woodland Cemetery in Stockholm, Sweden, expresses continuity, unity, and variety.

**Dynamism and Stasis:** The handcrafted wood rockers designed and crafted by Sam Maloof express movement in both visual and visceral manner. Furniture that appears static, such as Emik Skoven’s Block stool expresses stasis. Dynamism and stasis are contrasting attributes in built form.

**Hierarchy and Emphasis:** Hierarchy, and emphasis point to priority, and relative value in design. Hierarchy and emphasis are achieved through the manipulation of location, color, size, texture, and shape. Form, color and material can emphasize primary, secondary, and tertiary levels of importance and meaning.

Formal hierarchy can reinforce social status, such as the person sitting at the short end of a long rectangular conference table. In this sense, social, cultural, and political meaning, parallel formal characteristic of hierarchy.

Emphasis is drawn from dominant and subordinate relationships. For example, one can emphasize the vertical elements of a shelving system by using distinct materials and details to draw the eye. Shape differences and contrast levels can help designers distinguish dominant and subordinate relationships in their wok.

**Contrast:** Contrast or juxtaposition is the simultaneous experience of the relationships between contrasting elements or characteristics. Examples include a curvilinear form juxtaposed with an orthogonal shape and a light, reflective surface juxtaposed with a dark matte finish.

**Rhythm and Pattern:** The world rhythm derives from the Greek term rhythmus, meaning “to flow” Rhythm is the foundation of music dance poetry, and design. Rhythm is the structure and order of elements in space or time.

Rhythm is also the order of temporal daily experiences such as waking and sleeping, including monthly and seasonal patterns, and life-cycle events such as birth and death.

Pattern is the arrangement of elements that determine a whole and are made from points, lines, and shapes. Rhythm and pattern are codependent and inherent aspects in design. They reveal the underlying structure of from through physical spatial, or temporal compositional order.
Scale and Proportion; Scale and proportion are dependent upon physical and spatial relationships, although important distinctions need to be made between these terms. Scale is based upon the size of one thing relative to another, such as the size of a sectional sofa in relation to the size of a room. Proportion is the geometric correlations between parts and between parts and the whole.

Scale; furniture very often appears larger or smaller in its intended spatial context than it did in the shop where it was fabricated. The perception of scale depends upon the size of the furniture and the spatial context in which it is placed. When the surrounding spatial environment changes, the relative perception of size will change as well though the proportions of the furniture have not changed.

Proportion; is not about size, nor is it about the perception of scale. It is the mathematical relationships of a part, or parts of a design, to other parts within a given field or frame of reference. We recognize furniture by its proportions, identifying the relationships between seat pan to seat back and leg dimensions to table height dimensions.

Proportion is the relationship between with and length and concurrently, between height and depth. Furniture can appear visually heavy or light, compressed or extended. How we characterize the physical and spatial relationships of furniture reveals proportional relationships of the design.

Proportion is based upon a variety of tangible references. Naturally, the human body is the most common reference used in the design of furniture. Other proportional systems include mathematical or geometric systems such as the Golden Mean, the Fibonacci sense of numbers, the root system, fractal geometry and logarithmic or parabolic geometry (Zelanski, 1984), (Kawakami, 1988), (Schuster, 2000), (Beyazıt, 2000), (Gürer, 2004), (Güngör, 2005), (Postell* 2012), (Çellek, 2014).

Design Thinking
Design draws upon working methods and processes guided by specific ways of thinking.

*Empirical knowledge gained by doing, synthesized from prior experience (e.g. painting, driving, cooking, etc.).

*Intuition and judgment guided by subjective and objective assessment

*Deductive and inductive reasoning based upon rational, logical, and linear working methods to formulate connections between ideas and concrete realities

*Abductive modes of operating creative associations – improvisational methods of working.

Furniture design results from all four ways of working. However, deductive and inductive reasoning are the most teachable methods of design and therefore are described in this section.

Inductive reasoning involves an understanding of ideas and concepts that stem from specific knowledge and concrete realities. Designing a chair around the limitations of a particular material or specific joinery techniques entails the use of the inductive process in a search for form.

Mistakes encountered along the way are considered research for both the designer and the maker. Mistakes can help improve ideas and processes that over time develop into intuitive working processes.

Deductive reasoning is a process of generating concrete realities from conceptual or form inspired beginnings. It involves working and thinking that begin with conceptual ideas and develop into grounded specifics.

Based upon a conjecture-analysis model, designers put forward ideas through sketching, drawing, or modeling and then proceed to analyze and critique the effort, seeking to refine
and transform the idea into a specific resolution. The processes is repeated (many times) until the designer is able to synthesize all areas into a workable, resolved design. Deductive and inductive reasoning are linear processes involving conjecture and analysis, but design is not always linear or logical. Furniture designers are creative individuals with a capacity to think laterally, intuitively, tangentially, or thematically. However, lateral thinking knows no conclusive endpoint in the design process, and at some point, designers need to stop designing and test what they have accomplished. Abductive modes of operating are processes that formulate associative links—often guided by metaphor or allegory. Abductive operations are not rationally directed, however these often guide the process that most designers use to design. Designing furniture’s is a mix of rational-linear working processes and intuitive-subjective decisions made throughout the conception, development, and resolution phases of the design process (Kawakami, 1988), (Forgacs, 1995), (Postell* 2012).

**Construing and Constructing:** Designing furniture is a creative activity shaped by the dialogue between thinking and making. Thinking and making bond the processes of design with the limits of fabrication. With hands firmly grounded in the world of materials and tools and the mind engaged in the ever-expanding realm of ideas, furniture designers work to connect and infuse ideas with physical realities. How furniture looks and feels is often dependent upon how well it was made. Furniture designers attempt to design well—engineered, sturdy furniture but the academic and professional division between design and fabrication can make the process of investigating and resolving engineered solutions difficult. Hand drawings and computer renderings respond neither to applied forces nor to the properties of material. Scaled models can respond to gravity and lateral forces but cannot reveal the integrity of materials and the strength of joinery in the reduced scale of a study model. Reflecting upon “the making” often results in better-engineered and better-fabricated furniture. In this regard, the design process should include a three-dimensional sketch, one or more studies of structural promise, scale model(s), full-scale mock-ups, mechanically tested models, and working prototypes(

**o Making Prototypes:** Detail studies can be modeled or drawn at full scale and are useful in resolving difficult or complicated aspects of design. When the opportunity arises, making a working prototype at full scale can help test and analyze aspects of the design. A working prototype allows one to refine design ideas before committing to production.

**o Skale Models:** Scaled models of furniture placed in interior models show relationships, between furnishings and interior space and reveal notions of scale, layout, and proportion. Models, buildings and interior, spaces can be fabricated precisely and relatively quickly out of white museum board, foam core, or basswood. Materials can inspire design ideas working with materials in the development of design increases the effectiveness of the design process. In this regard, material boards and material sample arrangements are effective means of helping designers consider physical and visual materials for interior space, furniture, or a building (Kawakami, 1988), (Postell* 2012).

**Design Ethos**

**Accessible Design:** Accessibility is concerned with issues of access and egress, while universal design is a concept of designing for trans generational use, left-or right-handed users, pan-cultural uses, individuals without vision, and so on. Furniture designed with accessibility in mind would exclude beanbag chairs, hammocks, and chairs with narrow seat pans and tall arms because of the difficulty some persons have in
accessing these designs. In these examples, getting in can be difficult and getting out often more so.

Accessible furniture includes lift chairs, adjustable tables, and adjustable seating. Chairs and tables that are lightweight, have movable casters, and are stackable so that the floors can be cleaned or the space rearranged respond to issues of accessibility.

**Codes, Guidelines, and Standards (Health, Safety, and Welfare);** Codes and technical standards exist for the health, safety, and welfare of individual users. Many have been developed for specific types of furniture, especially chairs.

Ergonomic requirements for office work, with visual display terminals (VDTs) have been specified by ISO 9241-5; 1988, ISO 7174 specifies stability of rocking and tilting chairs.

**Green Design;** Concern for sustainability is more than a matter of compliance with industrial regulation or environmental impact analysis. It embraces a commitment to conceive of the work of design as a part of a wider context in time and places; (The Hannover Principles, William McDonough Architects, 1992).

Today, furniture designers, invoke green design in more complex and subtle ways. Green design considers distribution and packaging, biodegradability, the life cycle of materials and products, off-gassing, toxicity in fabrication or use, and a number of other important factors including human rights and labor standards (Cerver, 2000), (Miller,2005), (Postell* 2012), (Gura,2012).

Sustainable design solutions minimize negative and maximize positive impacts including social, economic, ethical, and environmental considerations. Leading-edge environmental thinkers and policy makers believe that sustainable development will require a “factor 4” improvement in the environmental performance of goods and services.

**Universal Design;** Universal design, attempts to meet the needs of people of all ages, abilities, and cognitive skills. Set forth as a concept by Ron Mace of the Center for Universal Design at North Carolina State University in 1990, universal design focuses on the “range of abilities” rather than the “limit of disabilities”

Universal design strives to accommodate the greatest range of user ‘8-80 years of age’ and abilities (wheelchair users, arthritic users, blind and deaf users, etc.) regardless of the user’s height, weight, or health.

Adjustability and size transformation are strategies used to address the challenge of designing for all people. However, design that responds to a wide range of users without transformation or adjustment reveals inherent qualities of universal design.

*Desks that are designed for left-and right-handed users*
*Desks and tales that have adjustable height work surfaces*
*Mobile desks and pedestals to rearrange the work space for personal needs*
*Writing tablets for both left-and right-handed users*
*Tables that accommodate all users, if only for limited tasks*
*Chairs that consider access and egress as well as ergonomic qualities*
*Shelving that accommodates wheelchair users*
*Case goods that can be opened and accessed by blind individuals*
*Cabinets that can be utilized by individuals with arthritis (Cerver,2000), (Beyazıt,2000), (Miller,2005),(Özen,Efe,2010),(Postell* 2012),(Gura,2012).

**Furniture Design Process**
‘Designing, entails the transformation of ideas into physical form’ (Postell* 2012).

Designing furniture relies upon a continual process of making informed, objective, and subjective judgments. The process involves formulating conjectures about form and function, analyzing, the efforts, and synthesizing design ideas into a product. It is known as the
conjecture/analysis/synthesis method. The process is cyclical, one that the designer revisits time and time again with every project.

As previously discussed, designers, generally begin the process of design with a sketch or simple model and proceed to explore ideas and conjectures by sketching, drawing, using computer software, and making study models. Sometimes designers begin the process of design in the shop and work directly with tools and materials to generate or explore ideas that can result in new forms or induce new ways of considering design ideas. During this phases assumptions may need to be suspended in order to synthesize fresh ideas, consider new materials, and integrate aspects of utility into a coherent whole (Kawakami, 1988), (Alberti, and others, 1989), (Beyazıt, 2000), (Postell, 2012).

**Sketching, Drawing, Computer Rendering, and Model Making:** Sketching is an important design skill that helps designers think visually on paper. Design generally evolves by sketching—typically in a freehand manner, freely annotated, allowing the designer to explore ideas as they occur. Sketching is an informal, image based investigation. It is a way of graphically communicating ideas.

Model studies can serve the same function as sketching and are an equally valid method for beginning the design process. At a later stage, design ideas are drawn, technically drafted by hand, or plotted and can be rendered by the computer. Today, modeling software is becoming more intuitive, enabling the development as rapid visualization of initial design ideas.

Computer software is beginning to emerge as a design tool in the initial phases of design as more and more designers are learning how to use software programs such as Sketch-it, Form Z, Auto Cad, 3-D Studio Max, Alias, and Maya. Consider computer software as more than just a tool for visualization. Digital programs and digital tools to generate design are available to everyone (Kawakami 1988), (Alberti,1989), (Beyazıt,2000), (Döngel,2013), (Postell*2012). Sketching and drawing help designers study composition ideally, drawing should be done at full scale. This helps designers consider aspects of from proportion, and detail at 1:1. and consider accurate measurements and materials in the development of a design. It reduces the void between designing how something might look and how it might be fabricated. Drawing is more than a means to an end. It is a technique designers use to explore, see, analyze, and refine their work.

Full-scale drawings correlate with full-scale thinking, but there are times when it is best to begin the process by freely exploring ideas at a reduced scale such as 1:10 in metric or 1”=1”. It is often easier to consider and compare initial ideas and explore variations of design in this manner.

An’ esquisse’ sketch. Is an expression of the basic on essential ideal / concept of a design.

A’ parti’ sketch communicates the basic physical and spatial components of a design. It is an analytical diagram, useful in developing an understanding of compositional aspects in design. Iterative sketches help designers evolve and refine design ideas. Such sketches (and drawings) explore variations of selected aspects of design while other aspects remain constant. Iterative sketches could include a series of overlays used to investigate a detail of furniture while the overall composition remains constant.

Table profiles, seat back angles, material joinery, and specific proportional investigations of an arm of a chair or a leg of a table are examples of specific areas that can be explored using iterative sketches. Furniture designers may complete hundreds of iterative sketches for a single piece of furniture.

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Iterative sketches can involve any drawing type (i.e. perspective study, elevation, or section study) and any scale of drawing, be it full-scale, reduced scale, or in some cases no particular scale but care for the relative proportions of the design. The overlay method of placing tracing paper over an existing drawing is a conventional means of producing iterations.

However, the process can include a number of other methods ranging from filling a journal of notebook to executing a number of study models in the investigation or exploration of a detail, or any aspect of the design, be it material, color or composition. Iterative sketches and study models are useful methods to refine and develop particular aspects or nuances of a design while keeping some aspects constant which distinguishes them from explorative drawings.

The scale is large enough to resolve basic aspects of form, but larger-scale drawings are necessary to resolve technical aspects and details of a piece. Working drawings for furniture are referred to as fabrication drawings (buildings are constructed, furnishings are fabricated). Fabrication drawings include the technical information necessary to fabricate the design, indicating dimensions materials and specifications for finish.

RAFTING PRECISE HARD-LINED DRAWINGS IS AN IMPORTANT SKILL TO ACQUIRE, DESPITE THE ABILITY TO USE COMPUTER SOFTWARE TO PRECISELY RENDER AND PLOT FURNITURE DRAWINGS. FABRICATION RELIES UPON EXACT DIMENSIONS, ACCURATE DETAILS, USE OF APPROPRIATE MATERIALS AND RESOLVED ENGINEERING. THE PROCESS OF DRAFTING WORKING DRAWINGS BY HAND CAN HELP DESIGNERS UNDERSTAND EACH LINE AND JOINT. WORKING DRAWINGS MUST REPRESENT DESIGN INTENTIONS.

**O Making Prototypes:** Detail studies can be modeled or drawn at full scale and are useful in resolving difficult or complicated aspects of design. When the opportunity arises, making a working prototype at full scale can help test and analyze aspects of the design. A working prototype allows one to refine design ideas before committing to production.

**O Scale Models:** Scaled models of furniture placed in interior models show relationships, between furnishings and interior space and reveal notions of scale, layout, and proportion. Models, buildings and interior, spaces can be fabricated precisely and relatively quickly out of white museum board, foam core, or basswood.

Materials can inspire design ideas working with materials in the development of design increases the effectiveness of the design process. In this regard, material boards and material sample arrangements are effective means of helping designers consider physical and visual materials for interior space, furniture, or a building (Kawakami,1988), (Alberti,1989), (Postell *2012).

**Furniture Design Phases**
Furniture design can be organized into phases. Designers can determine where they are in the process of designing furniture by understanding the expectation, for each phase of work Designers rarely skip a phase, thought the process can move back ward as well as forward. Designers can spend more time on one phase, than another. There are few rules in design that cannot be broken.
It is ineffective to micro-manage the sequence of the design phases. However a degree of flexibility should always be factored into the process of design. An enormous amount of time may be used to research and program ideas of “sitting” when designing a chair for the first time. The design development phase for a room divider might take a long time due to the complexity of the technical details.

Nonetheless, designers are expected to understand where they are in the process of design. Organizing the phases of designing furniture into a linear structure is useful to determine where one is in the design process-if not for one self, than for the client, who is likely to ask, “How far along in the design process are we?

Regardless of the means and methods of design there will always be phases to the process of design. An outline of design phases follows:

1. Predesign, Research, and Programming
2. Schematic Design
3. Design Development
4. Fabrication Drawings
5. Pricing and Contract Negotiation
6. Shop Drawings, Templates and Working Prototypes
7. Fabrication
8. Delivery and Installation

**Predesign, Research, and Programming;** ‘A well defined problem is 50% of the solution’ Albert Einstein.

The predesign, research, and programming phases, involve necessary work that designers generally accomplish before designing a piece of furniture. Even before the research and programming phases, designers must prepare themselves by organizing their personal time and committing to the project.

Designing furniture for a salon or spa may require a visit to various salons or spas to observe how hair is cut and how customers and staff interact with one another. When designing furniture for a particular space, existing architectural conditions may need to be recorded in order to accurately represent important aspects and dimensions of the space. Observation, documentation, and analysis provide an important foundation in the process of design and are considered predesign work.

Predesign, research, and programming may also entail research of technical standards driven by code, economic, or fabrication limitations. Generally, this phase of design takes a significant amount of time to complete-time that the client is not usually eager to pay for.

Programming can be as brief as a few written notes or as complex as a booklet. A program articulates in written form the goals and objectives of the design process. It is a tool to guide the design process and shape the parameters for how the design will be evaluated it is an effort to organize and define the scope of work, the purpose of the work the resources and conditions in which the work will be placed, and the schedule for all aspects of the work.

Though they bring no guarantee of success, programming and research efforts may increase the likelihood for a successful project. Regardless of the method one uses to determine the program and establish the intended purposes for the furniture that will be designed, basic questions can and should be considered by the designer. These questions are based upon six terms, who, what, why, when where, and how.

**WHO**

*Who is in the market for this product?*
*Who will use this product?*
*Who will sell or distribute the product?*
*Who will maintain the product?
WHAT
*What is its intended purpose?
*What are other things it might do?
*What is the competition?
*What functions should be included?
*What is the life expectancy?
*What is the expected cost for the furniture?

WHY
*Why is the furniture design needed?
*Why would someone buy this product?
*Why is a new design needed?
*Why will the furniture be used?
*Why use hand machine or digital technology in its fabrication?

WHEN
*When will the furniture be used?
*When will the product require maintenance?
*When will it not have enough capacity?
*When will it be stored or moved?

WHERE
*Where will the furniture be located?
*Where should it not be located?
*Where will it be sold?
*Where with its materials come from?
*Where will it be fabricated?

HOW
*How does it work?
*How is it used?
*How many functions will be served?

*How well does it relate to all people (Kawakami, 1988), (Beyazıt, 2000), (Postell* 2012).

**Schematic Design;** Schematic design is generally considered the first phase in the process of designing furniture. During this phase general decisions regarding size and form are explored. Sketches and rough study models are made to communicate ideas and study compositional aspects. There may be some degree of resolution regarding materials selection or detail, but generally these aspects are unresolved.

**Design Development;** In this phase, designers refine ideas, formulate general dimensions and materials, and resolve the direction of the work. At the end of this phase, decisions regarding size proportion material, color selection, and visual quality will have been explored and generally made. While further resolution of detail and joinery may be needed the basic formal qualities of the design should be determined at this point.

**Fabrication Drawings;** Fabrication drawings also referred to as construction drawings, working drawings, or contract documents, are given by designers to fabricators for pricing and fabrication. All critical views of the design need to be shown and clearly delineated on paper or in the computer before fabrication can begin. In preparing fabrication drawings, designers explicitly resolve and delineate remaining design decisions before fabrication. During this phase, dimensions, material selection, grain direction of the wood, specifications for quality, finish selection, fabrication details, and technical

For mass produced furniture fabricated out of metals and plastics, the tolerances are even finer, requiring dimensional resolution. Technical sources are available to help designers determine how to specify and detail contract documents and how to avoid undesirable surprises in fabrication.

**Pricing and Contract Negotiation;** One can approximate the probable cost of fabrication during design development, but is impossible to accurately determine the cost of fabricating furniture until the construction drawing and specifications are complete. Miles van der Rohe said, “God is in the details” he was right, but the neglected to add that “the Devil is in there, too”.

**Shop Drawings, Templates, and Working Prototypes;** Once fabricator is selected and a contact between client and fabricator, is made, the fabricator prepares show drawing and templates and, in some cases, produces a working prototype to test aspects of the design. Shop drawing and working prototypes represent the most detailed and explicit type of information about the design. They are made during the transitional phase between design and fabrication. Shop drawing might lead to a mock-up of a detail or indicate the need to review and modify the contract drawings. Shop drawings should always be reviewed and approved by the designer. These are the documents that remain well after production is over and are referred to if disputes or problems arise.

Working prototypes are useful in testing and resolving aspects of form and structure. They mark the last phase prior to producing the final work. This phase in the process of design is critical-taking carefully rendered drawings of design ideas into most challenging phase. Templates and form are often made in order to fabricate a working prototype

**Fabrication;** The fabrication is very important phase, because refine ideas of the designer will transform a physical structure and fabricator wants to make a profit from the design in this case.

**Delivery and Installation;** Delivery and installation is an important phase of work that needs to be carefully planned and included in the overall cost of fabricating the work (Nothhelfer, 1948), (Spannagel, 1954), (Klatt, E., 1973), (Groneman, 1976), (Kawakami 1988), (Alberti, and others, 1989), (Beyazıt, 2000), (Postell* 2012).

### 10. MATERIALS

It is assumed that during ancient times, ‘furniture’ was constructed from readily available naturel materials (especially wood) and worked by hand into useful objects. Recently, materials have been designed at the molecular level (i.e., polymers), and those efforts, nanotechnologies have emerged as a means to create biomaterial, many of which are biodegradable. Today, the technology is available to design and make almost anything. Designer need to understand why one material is better or more appropriate than another for a given situation. They should be informed about the newest materials and have a working knowledge of material properties.

Materials contribute significantly to the structural integrity, comfort, and aesthetics of furniture. Considering the properties and characteristics of materials in the conception of design focuses the designer’s thinking upon the limits and constraints of materials, which, ironically, opens the door to creative design ideas.

Today, material research focuses upon environmental issues, physical properties, health-related concerns, and performance – related characteristics. Digital technology and new
materials have an enormous potential to influence the field of furniture design (Anderson, 1973, (Kollmann F., 1982), (Walker, A., 1989), (Alberti, and others, 1989), (Postell* 2012). Unfortunately, we must round out the subject and references of the materials, because of the rules for conference papers limits right now.

11. FABRICATION

Furniture with a high level of workmanship usually takes more than one might anticipate, so it pay to plan and be organized. Before beginning the process of making furniture, it is wise to make a list of the materials, tools, hardware, and supplies needed and to prepare a schedule to guide the fabrication process. Not only should one consider the quantity of materials necessary to make the furniture, but also the quality, availability, and cost of the materials specified (Ebinghaus, H., and Heussen, F., 1960), (Groneman, 1976), (Umezu, 1988), (Alberti, and others, 1989), (Efe, Gürleyen, İmirzi, 2003), (Postell* 2012). Unfortunately, We must round out the subject and references of the fabrication, because of the rules for conference papers limits here.

12. MARKETING

Furniture is a relatively expensive product to bring to market, which contributes to a limited customer pool. Furthermore, consumers want more than comfortable and affordable furniture. Many want social status, beauty, structural integrity, and environmentally green design. The market is comlex, driven by individual and societal needs and desires (Efe and Arslan, 2008), (Postell* 2012). Unfortunately, we must round out the subject and references of the marketing, because of the rules for conference papers limits right now. Furthermore, the visual documents such as furniture pictures will be presented in the date of conference by this paper writer.

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